

1/10/87

10/529571

JC13 Rec'd PCT/PTO 29 MAR 2005

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Spectrally broadband light source of high optical power

The invention relates to a light source of spectral
5 broadband type of high optical power for fiber optic
applications, in particular for use in fiber optic
interferometers or fiber optic gyroscopes (FOGs).

Superluminescent diodes have been used to date as light
10 source in fiber optic sensors, in particular in FOGs,
in order to ensure the two central requirements of, on
the one hand, spectral broadbandedness, and, on the
other hand, adequate optical power to be launched into
the fiber. Such light sources are special components
15 that are comparatively very expensive because of their
low piece numbers. Commercially available, inexpensive
alternatives would be light-emitting diodes (LEDs) or
laser diodes (LDs). LEDs do not fulfill the power
criterion, but on the other hand LDs do not exhibit the
20 spectral properties to be required.

It is therefore the object of the invention to provide
a spectrally broadband light source of high optical
power for fiber optic applications that can be produced
25 cost effectively in an economic automatic mass
production process, and thus in large piece numbers.

A spectrally broadband light source of comparatively
high optical power for fiber optic applications, in
30 particular for fiber optic sensors, is characterized by
a monolithic linear array, arranged on a substrate, in
particular a wafer or chip, of adjacent
surface-emitting LEDs, and a microoptics, arranged
upstream of the monolithic LED linear array on the
35 emission side at a prescribed spacing, having optical
functions individually assigned to the LED elements in
such a way that for the purpose of optimizing the

optical power that can be launched into an optical fiber, the emission of the individual LEDs is focused onto an onto an optical unit arranged upstream of the launch point of the fiber.

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The optics unit is preferably designed as a spherical lens arranged at an end of the fiber into which light is radiated.

10 Apart from fiber optic sensors, the invention is also suitable for specific applications in metrology, in particular in telecommunications, that is to say wherever a spectral broadbandness is required, for example in the measurement/calibration of WDM or DWDM
15 systems.

Thus, the idea of the invention consists in the suitable combination of a number of techniques and elements that are basically available, specifically:

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- high power LEDs,
- precise microoptics for beam focusing of the lights output by the individual LEDs, and
- a suitable further optics for optimally launching the focused optical power into an optical
25 fiber.

The actual light source is an array, preferably a lens array in combination with high power, surface-emitting LEDs. The criterion of spectral broadbandness can be
30 met with the latter. Such LEDs can be completely tested on the common wafer. The array consists of LEDs, adjacent at a small spacing, on the wafer, the respective number of which is determined by the subsequent optical units for beam deflection and
35 focusing as well as by the required optical power.

A special microoptics is mounted on the monolithic LED array. This optic consists of an array of individual optical functions in order to focus the more or less

three-dimensional emission of the individual LEDs on the chip into a respectively parallel emission. The criterion of the desired high optical power is met by this summing of the individual optical powers of the individual LEDs. The use of the most recent methods from the fields of microoptics yields a complex optical functionality in conjunction with very good adaptation to the LED array. The focusing is performed here very precisely in adaptation to the individual LEDs of the array and is, if appropriate, optimized for each of these LEDs of the array with regard to the direction of emission. These requirements can be implemented very effectively with the aid of a microoptics, specifically in a monolithic fashion in a single module. A further optics unit, for example a spherical lens mounted at the end face of the fiber is used for beam focusing and for optimizing the launch into the fiber.

An exemplary embodiment of the invention is explained below in detail with reference to the drawing of **Figure 1** (sole figure).

Constructed on a substrate 1, in particular a suitable wafer or chip substrate, along a reference line or edge 7 is a linear array of preferably equally spaced high power and surface-emitting LEDs that can all be completely tested directly on the wafer with the aid of known test methods. Located at a short spacing in the direction of the emission of the LEDs 3 is a lens array 4 whose individual elements 4 are respectively aligned in each case with one of the LEDs 3. The optical elements of the lens array 4 are, for their part, fashioned and aligned such that the light beams of the individual LED elements 3 are focused onto a collecting optics 5 that is preferably a collecting optics 5, for example a spherical lens, arranged upstream of or on an optical fiber 6.

The following substantial advantages are achieved with the invention:

1. Essential steps in processing and testing can be
5 carried out as batch processing. This leads to substantially lower production costs, in particular in the case of chip production and by comparison with the production costs for a single superluminescent diode having comparable
10 properties.
2. The production of the chip with the LED linear array and the lens array is performed using known
15 processes of mass production.
3. The chips can be adapted comparatively easily to the respective current state of the art in order easily to utilize a growth potential of this novel technique which is mastered in principle by a
20 majority of chip manufacturers.